WHAT IS CLAIMED IS:

1.   A Reed-Solomon decoder comprising:

a storing part;

a calculation part for calculating an error location and an error value

5   from (2m) bit data from the storing part; and

a control part for correcting an error of the data according to the error

location and the error value, and controlling the calculation part to output a

decoded signal.

2.   The decoder according to claim 1, wherein the calculation part

comprises:

an eraser location polynomial calculation part for calculating an eraser

location polynomial from an eraser flag from the storing part;

5   a first syndrome polynomial calculation part for calculating a first

syndrome polynomial from the data read from the storing part;

a second syndrome polynomial calculation part for calculating a second

syndrome polynomial from the data read from the storing part;

a first errata location polynomial calculation part for calculating a first

10   errata location polynomial from the calculated eraser location polynomial and

first syndrome polynomial, and outputting the first errata location polynomial

and the delayed first syndrome polynomial;

a first error location/value calculation part for calculating a first error

flag, a first error location and a first error value from the first errata location

15   polynomial and the delayed first syndrome polynomial;

a second errata location polynomial calculation part for calculating a second errata location polynomial from the calculated eraser location polynomial and second syndrome polynomial, and outputting the second errata location polynomial and the delayed second syndrome polynomial; and

20   a second error location/value calculation part for calculating a second error flag, a second error location and a second error value from the second errata location polynomial and the delayed second syndrome polynomial.

3.   The decoder according to claim 1, wherein the calculation part comprises:

a first RS core for calculating a first error location and a first error value from the data read from the storing part; and

5   a second RS core for calculating a second error location and a second error value from the data read from the storing part.

4.   The decoder according to claim 3, wherein the first RS core comprises:

an eraser location polynomial calculation part for calculating an eraser location polynomial from an eraser flag read from the storing part;

5   a first syndrome polynomial calculation part for calculating a first syndrome polynomial from the data read from the storing part;

a first errata location polynomial calculation part for calculating a first errata location polynomial from the calculated eraser location polynomial and

32

first syndrome polynomial, and outputting the first errata location polynomial

10 and the delayed first syndrome polynomial; and

a first error location/value calculation part for calculating a first error

flag, a first error location and a first error value from the first errata location

polynomial and the delayed first syndrome polynomial.

5. The decoder according to claim 4, wherein the first syndrome

polynomial calculation part satisfies $S_j = \alpha^j(S_{j-1}\alpha^j+UM)+DM$ when (2m) bit

data is inputted; and satisfies $S_j = S_{j-1}\alpha^j+UM$ when (m) bit data is inputted,

wherein S_j indicates a current state syndrome polynomial, S_{j-1} is a preceding

5 state syndrome polynomial, α^j is a root of a generated polynomial, UM is up

(m) bits of the (2m) bit data, and DM is down (m) bits of the (2m) bit data.

6. The decoder according to claim 4, wherein the first syndrome

polynomial calculation part comprises:

a first syndrome storing part for temporarily storing a calculation result

of the first syndrome polynomial;

5 a first multiplier for multiplying the syndrome polynomial from the

first syndrome storing part by a root $\alpha^j(j=0, 1, \ldots, N-K-1)$ of the generated

polynomial;

a first adder for adding the output from the first multiplier to up (m)

(UM) bits of the input data;

10 a first (m) bit multiplexer for outputting 1 or α^j according to the (m) or

(2m) bit mode;

33

a second multiplier for multiplying the output from the first adder by the output from the first (m) bit multiplexer;

a second (m) bit multiplexer for outputting 0 or down (m) (DM) bits of the input data according to the (m) or (2m) bit mode; and

a second adder for adding the output from the second multiplier to the output from the second (m) bit multiplexer, the first syndrome storing part temporarily storing and outputting the output from the second adder;

wherein UM is up (m) bits of the (2m) bit data, and DM is down (m) bits of the (2m) bit data.

7. The decoder according to claim 4, wherein the second RS core comprises:

a second syndrome polynomial calculation part for calculating a second syndrome polynomial from the data read from the storing part;

a second errata location polynomial calculation part for calculating a second errata location polynomial from the calculated eraser location polynomial and second syndrome polynomial, and outputting the second errata location polynomial and the delayed second syndrome polynomial; and

a second error location/value calculation part for calculating a second error flag, a second error location and a second error value from the second errata location polynomial and the delayed second syndrome polynomial.

8. The decoder according to claim 7, wherein the second syndrome polynomial calculation part satisfies $S_j = \alpha^j(S_{j-1}\alpha^j + UM) + DM$ when

(2m) bit data is inputted; and satisfies $S_j = S_{j-1}\alpha^j + DM$ when (m) bit data is inputted, wherein S_j indicates a current state syndrome polynomial, S_{j-1} is a preceding state syndrome polynomial, α^j is a root of a generated polynomial, UM is up (m) bits of the (2m) bit data, and DM is down (m) bits of the (2m) bit data.

9.　　The decoder according to claim 7, wherein the second syndrome polynomial calculation part comprises:

a second syndrome storing part for temporarily storing a calculation result of the second syndrome polynomial;

a third (m) bit multiplexer for outputting 1 or α^j according to the (m) or (2m) bit mode;

a third multiplier for multiplying the output from the second syndrome storing part by the output from the third (m) bit multiplexer;

a fourth (m) bit multiplexer for outputting 0 or up (m) (UM) bits of the input data according to the (m) or (2m) bit mode;

a third adder for adding the output from the third multiplier to the output from the fourth (m) bit multiplexer; and

a fourth multiplier for multiplying the output from the third adder by a root α^j(j=0, 1, ..., N-K-1) of the generated polynomial; and

a fourth adder for adding the output from the fourth multiplier to down (m) (DM) bits of the input data, the second syndrome storing part storing and outputting the output from the fourth adder;

35

wherein UM is up (m) bits of the (2m) bit data, and DM is down (m) bits of the (2m) bit data.

10.   A Reed-Solomon decoder for processing (m) or (2m) bit data, comprising:

a storing part for storing (2m) bit data;

a main control part for controlling the storing part;

a first RS core for calculating a first error location and a first error value from the data read from the storing part;

a first RS core control part for controlling the first RS core under the control of the main control part;

a second RS core for calculating a second error location and a second error value from the data read from the storing part; and

a second RS core control part for controlling the second RS core under the control of the main control part.

11.   The decoder according to claim 10, wherein the first RS core comprises:

an eraser location polynomial calculation part for calculating an eraser location polynomial from an eraser flag from the storing part;

a first syndrome polynomial calculation part for calculating a first syndrome polynomial from the data read from the storing part;

a first errata location polynomial calculation part for calculating a first errata location polynomial from the calculated eraser location polynomial and

first syndrome polynomial, and outputting the first errata location polynomial

10   and the delayed first syndrome polynomial; and

a first error location/value calculation part for calculating a first error

flag, a first error location and a first error value from the first errata location

polynomial and the delayed first syndrome polynomial.

12.   The decoder according to claim 11, wherein the first syndrome

polynomial calculation part comprises:

a first syndrome storing part for temporarily storing a calculation result

of the first syndrome polynomial;

5   a first multiplier for multiplying the syndrome polynomial from the

first syndrome storing part by a root α^j (j=0, 1, ..., N-K-1) of the generated

polynomial;

a first adder for adding the output from the first multiplier to up (m)

(UM) bits of the input data;

10   a first (m) bit multiplexer for outputting 1 or α^j according to the (m) or

(2m) bit mode;

a second multiplier for multiplying the output from the first adder by

the output from the first (m) bit multiplexer;

a second (m) bit multiplexer for outputting 0 or down (m) (DM) bits of

15   the input data according to the (m) or (2m) bit mode; and

a second adder for adding the output from the second multiplier to the

output from the second (m) bit multiplexer, the first syndrome storing part

37

temporarily storing and outputting the output from the second adder;

wherein UM is up (m) bits of the (2m) bit data, and DM is down (m) bits of the (2m) bit data.

13.   The decoder according to claim 10, wherein the second RS core comprises:

a second syndrome polynomial calculation part for calculating a second syndrome polynomial from the data read from the storing part;

a second errata location polynomial calculation part for calculating a second errata location polynomial from the calculated eraser location polynomial and second syndrome polynomial, and outputting the second errata location polynomial and the delayed second syndrome polynomial; and

a second error location/value calculation part for calculating a second error flag, a second error location and a second error value from the second errata location polynomial and the delayed second syndrome polynomial.

14.   The decoder according to claim 13, wherein the second syndrome polynomial calculation part comprises:

a second syndrome storing part for temporarily storing a calculation result of the second syndrome polynomial;

a third (m) bit multiplexer for outputting 1 or α^j according to the (m) or (2m) bit mode;

a third multiplier for multiplying the output from the second syndrome storing part by the output from the third (m) bit multiplexer;

38

a fourth (m) bit multiplexer for outputting 0 or up (m) bits of the input

10   data according to the (m) or (2m) bit mode;

a third adder for adding the output from the third multiplier to the

output from the fourth (m) bit multiplexer; and

a fourth multiplier for multiplying the output from the third adder by a

root α^j(j=0, 1, ..., N-K-1) of the generated polynomial; and

15   a fourth adder for adding the output from the fourth multiplier to down

(m) bits of the input data, the second syndrome storing part storing and

outputting the output from the fourth adder.

15.   A Reed-Solomon decoding method comprising the steps of:

reading data to be decoded and an eraser flag;

calculating an error location and an error value from the read data; and

correcting an error of the data according to the calculated error location

5   and error value, and decoding the data.

16.   The method according to claim 15, wherein the data is read in

(2m) bit units in the data reading step.

17.   The method according to claim 15, wherein the data reading

step comprises:

an eraser location polynomial calculation step for calculating an eraser

location polynomial from the read eraser flag;

5   a first syndrome polynomial calculation step for calculating a first

syndrome polynomial from the read data;

a second syndrome polynomial calculation step for calculating a second syndrome polynomial from the read data;

a first errata location polynomial calculation step for calculating a first

10   errata location polynomial from the calculated eraser location polynomial and first syndrome polynomial, and outputting the first errata location polynomial and the delayed first syndrome polynomial;

a first error location/value calculation step for calculating a first error flag, a first error location and a first error value from the first errata location

15   polynomial and the delayed first syndrome polynomial;

a second errata location polynomial calculation step for calculating a second errata location polynomial from the calculated eraser location polynomial and second syndrome polynomial, and outputting the second errata location polynomial and the delayed second syndrome polynomial; and

20   a second error location/value calculation step for calculating a second error flag, a second error location and a second error value from the second errata location polynomial and the delayed second syndrome polynomial.

18.   The method according to claim 15, wherein the calculation step comprises:

a first calculation step for calculating a first error location and a first error value from the read data; and

5   a second calculation step for calculating a second error location and a second error value from the read data.

19.   The method according to claim 18, wherein the first calculation step comprises:

an eraser location polynomial calculation step for calculating an eraser location polynomial from the read eraser flag;

5   a first syndrome polynomial calculation step for calculating a first syndrome polynomial from the read data;

a first errata location polynomial calculation step for calculating a first errata location polynomial from the calculated eraser location polynomial and first syndrome polynomial, and outputting the first errata location polynomial

10   and the delayed first syndrome polynomial; and

a first error location/value calculation step for calculating a first error flag, a first error location and a first error value from the first errata location polynomial and the delayed first syndrome polynomial.

20.   The method according to claim 19, wherein the first syndrome polynomial calculation step satisfies $S_j = \alpha^j(S_{j-1}\alpha^j+UM)+DM$ when (2m) bit data is inputted; and satisfies $S_j = S_{j-1}\alpha^j+UM$ when (m) bit data is inputted, wherein S_j indicates a current state syndrome polynomial, S_{j-1} is a preceding

5   state syndrome polynomial, α^j is a root of a generated polynomial, UM is up (m) bits of the (2m) bit data, and DM is down (m) bits of the (2m) bit data.

21.   The method according to claim 18, wherein the second calculation step comprises:

a second syndrome polynomial calculation step for calculating a

41

second syndrome polynomial from the read data;

5 a second errata location polynomial calculation step for calculating a second errata location polynomial from the calculated eraser location polynomial and second syndrome polynomial, and outputting the second errata location polynomial and the delayed second syndrome polynomial; and

a second error location/value calculation step for calculating a second

10 error flag, a second error location and a second error value from the second errata location polynomial and the delayed second syndrome polynomial.

22. The method according to claim 21, wherein the second syndrome polynomial calculation step satisfies $S_j = \alpha^j(S_{j-1}\alpha^j+UM)+DM$ when (2m) bit data is inputted; and satisfies $S_j = S_{j-1}\alpha^j+DM$ when m bit data is inputted, wherein S_j indicates a current state syndrome polynomial, S_{j-1} is a

5 preceding state syndrome polynomial, α^j is a root of a generated polynomial, UM is up (m) bits of the (2m) bit data, and DM is down (m) bits of the (2m) bit data.

23. An inner code correction method of a Reed-Solomon production code, comprising the steps of:

calculating a first syndrome polynomial from inner code words received in (2m) bit units;

5 calculating a second syndrome polynomial from inner code words received in (2m) bit units;

calculating first and second errata location polynomials from the

42

calculated first and second syndrome polynomials and an eraser location polynomial; and

10   calculating first and second error values and first and second error locations according to the first and second errata location polynomials and the first and second syndrome polynomials, the errors being alternately corrected in (m) bit units.

24.   An outer code correction method of a Reed-Solomon production code, comprising the steps of:

calculating a first syndrome polynomial from up (m) (UM) bits of read (2m) bit outer codes and a second syndrome polynomial from down (m) (DM)

5   bits of read (2m) bit outer codes, and simultaneously calculating an eraser location polynomial by reading an eraser flag;

calculating first and second errata location polynomials from the first and second syndrome polynomials and the eraser location polynomial; and

calculating an error value and an error location from the first and

10   second errata location polynomials and the first and second syndrome polynomials, the errors being alternately corrected in (m) bit units;

wherein UM is up (m) bits of the (2m) bit data, and DM is down (m) bits of the (2m) bit data.

25.   The method according to claim 24, wherein, an (m) bit correction mode is set for an operation of the Reed-Solomon decoder in (m) bit units, storing the (m) bit data in an up (m) bit memory of a storing part, and

disabling a second RS core so that the second RS core cannot access the

5　　storing part.

26.　　The method according to claim 23, wherein calculating a first syndrome polynomial and a second syndrome polynomial satisfies $S_j = \alpha^j(S_{j-1}\alpha^j+UM)+DM$ when (2m) bit data is inputted; wherein S_j indicates a current state syndrome polynomial, S_{j-1} is a preceding state syndrome

10　　polynomial, α^j is a root of a generated polynomial, UM is up (m) bits of the (2m) bit data, and DM is down (m) bits of the (2m) bit data.

27.　　The method according to claim 24, wherein calculating a first syndrome polynomial and a second syndrome polynomial satisfies $S_j = \alpha^j(S_{j-1}\alpha^j+UM)+DM$ when (2m) bit data is inputted; wherein S_j indicates a

15　　current state syndrome polynomial, S_{j-1} is a preceding state syndrome polynomial, α^j is a root of a generated polynomial, UM is up (m) bits of the (2m) bit data, and DM is down (m) bits of the (2m) bit data.

28.　　The decoder according to claim 12, wherein the first syndrome polynomial calculation part satisfies $S_j = \alpha^j(S_{j-1}\alpha^j+UM)+DM$ when (2m) bit

20　　data is inputted; and satisfies $S_j = S_{j-1}\alpha^j+UM$ when (m) bit data is inputted, wherein S_j indicates a current state syndrome polynomial, S_{j-1} is a preceding state syndrome polynomial, α^j is a root of a generated polynomial, UM is up (m) bits of the (2m) bit data, and DM is down (m) bits of the (2m) bit data.

25　　29.　　The decoder according to claim 14, wherein the second

44

syndrome polynomial calculation part satisfies $S_j = \alpha^j(S_{j-1}\alpha^j+UM)+DM$ when

(2m) bit data is inputted; and satisfies $S_j = S_{j-1}\alpha^j+DM$ when (m) bit data is

inputted, wherein S_j indicates a current state syndrome polynomial, S_{j-1} is a

preceding state syndrome polynomial, α^j is a root of a generated polynomial,

30   UM is up (m) bits of the (2m) bit data, and DM is down (m) bits of the (2m)

bit data.

30.   The method according to claim 15, wherein the correcting an

error step comprises:

35   a first error correction step for correcting the read data from the first

error value and the first error location from the read data; and

a second error correction step for correcting the read data from the

second error value and the second error location from the read data.